# D1GIT:

## AUTOMATED, TEMPERATURE-CALIBRATED MEASUREMENT OF CAPILLARY REFILL TIME

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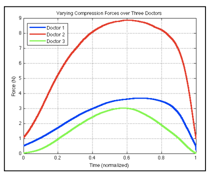
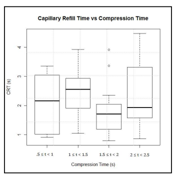
## SUMMARY

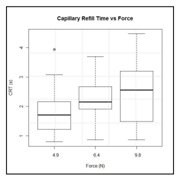
Team 6 has designed and prototyped an automated device to measure capillary refill time. The capillary refill test, used medically to test for shock and/or dehydration, is currently conducted manually: the practitioner depresses the patient's finger for an arbitrary time with an arbitrary amount of force, relying on his/her own judgment to quantify the rate of returning blood flow. To address the need for a standardized capillary refill test, our device, the *D1GIT*, performs three main functions: standardizing the force applied to the patient's finger, sensing the blood flow returning to the finger, and outputting a digital reading of temperature-adjusted capillary refill time. Prior art in this area has been limited to the development of sensing techniques that output a digital reading of refill time but still require unregulated manual application of force to the patient's finger independent of the sensing setup. Therefore, the *D1GIT* is a novel device in that it is a compact solution for standardizing the capillary refill time test, incorporating and facilitating *all* of the actions of a human doctor.

## APPLYING FORCE TO THE FINGER

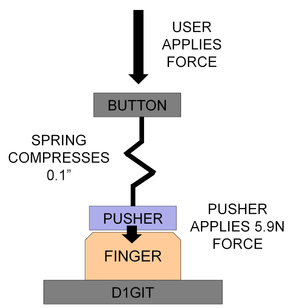
Testing of compression by three doctors showed large inter-doctor variability in applied force. Preliminary testing showed that CRT is dependent on force applied but not compression time.

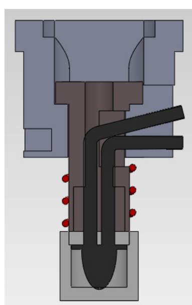


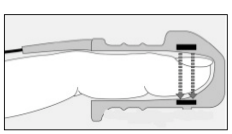

D1GIT features a 2.3 N/mm spring calibrated to compress 2.5mm so that the pusher will apply a 5.9N force to each patient.

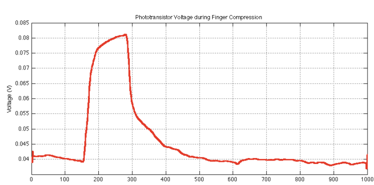


## SENSING AND MEASURING CRT

An IR LED and phototransistor detect blood flow. This sensing technology was validated through testing of 20+ subjects of varying race and gender.

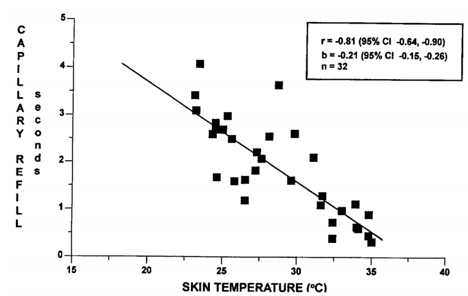






## TEMPERATURE CALIBRATION

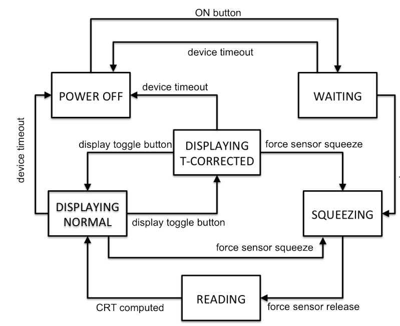
Previous research has determined an indirect linear relationship between skin temperature and CRT. D1GIT uses this algorithm to account for patient skin temperature, which is measured with an integrated zener diode.

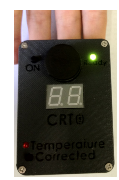


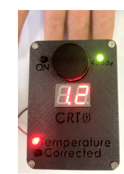

*"Effect of Ambient Temperature on Capillary Refill in Healthy Children", Gorelick, Shaw, Baker, *Pediatrics*, 1993

## SOFTWARE AND OPERATION

Embedded programming controlling the device can be represented by a *finite state machine* with five active states. Transitions between the states are triggered by events both internal and external to the microcontroller.





## PROTOTYPE DESIGN FEATURES

Five design iterations yielded an inexpensive electronic and mechanical solution ($65/device as is, much cheaper if mass produced). The final design features intuitive LED indicators to facilitate use, a printed circuit board, a small battery compartment, and compact wiring.